CLAIMS TO INVENTION

670. A planar laser illumination and imaging (PLIIM) based camera system for producing high-resolution 3-D images of 3-D object surfaces of arbitrary surface geometry moving relative to said PLIIM based camera system, said PLIIM-based camera system comprising:

a system housing having first, second, third and fourth light transmission apertures linearly aligned with and optically isolated from each other, and said third light transmission aperture being disposed between said first and second light transmission apertures;

an LADAR-based object profiling subsystem, disposed within said system housing, for projecting an amplitude modulated (AM) laser beam through said fourth light transmission aperture, and scanning said laser beam across an 3-D object surface of arbitrary surface geometry moving past said fourth light transmission aperture, so as to measure the surface profile of said moving 3-D object surface and produce a series of linear 3-D surface profile maps thereof as said 3-D object surface moves past said system,

wherein each said linear 3-D surface profile map comprises a set of 3-D coordinates specifying the location of sampled points along said moving 3-D object surface;

a linear imaging subsystem, disposed within said system housing, for producing a series of linear high-resolution 2-D images of said moving 3-D object surface as said 3-D object surface moves past said system,

wherein each said linear high-resolution 3-D image comprises a set of pixel intensity values, and each said pixel intensity value being assigned a set of two-dimensional coordinates specifying the location of the pixel in said linear high-resolution 2-D image, and

wherein said linear imaging subsystem includes

a linear image formation and detection module having image formation optics with a field of view projectable through said third light transmission aperture and onto said 3-D object surface moving relative to said first, second and third light transmission apertures during object illumination and imaging operations, and

a pair of planar laser illumination arrays (PLIAs) disposed in said system housing, each said planar laser array (PLIA) including a plurality of laser diodes arranged together in a linear manner and said planar laser illumination arrays being arranged in relation to said linear image formation and detection module, and for producing a pair of planar laser illumination beams (PLIBs), and projecting

said pair of stationary planar laser illumination beams through said first and second light transmission apertures and oriented such that the plane of said planar laser illumination beams is coplanar with the field of view of said linear image formation and detection module so that the object can be simultaneously illuminated by said planar laser illumination beams and imaged within said field of view of said linear image formation and detection module; and

an image processing computer, for constructing high-resolution 3-D images of said 3-D object surface using said linear 3-D surface profile maps and said high-resolution 2-D linear images of said moving object surface.

671. The PLIIM-based camera system of claim 670, wherein said image processing computer is disposed within said system housing.

672. The PLIIM-based camera system of claim 670, wherein said image processing computer further comprises:

means for producing a 3-D surface geometry model of said moving 3-D object surface using said linear 3-D surface profile maps;

means for mathematically projecting pixel rays from each pixel in each said captured linear high-resolution 2-D image;

means for computing the x, y, z coordinates associated with the points of intersection between these pixel rays and said 3-D surface geometry model; and

means for generating a linear high-resolution 3-D image of said moving 3-D object surface based on said computed points of intersection,

whereby each pixel in said high-resolution linear 3-D image comprises an intensity value I(x, y, z) and a set of x,y,z coordinate values specifying the location of the sampled point of said moving 3-D object surface.

673. The PLIIM-based camera system of claim 672, wherein said image processing computer further comprises means for assembling, in an image buffer, a set of consecutively computed linear high-

resolution 3-D images so as to construct an area-type high-resolution 3-D image of said moving 3-D object surface.

674. The PLIIM-based camera system of claim 673, wherein said image processing computer further comprises: means for mapping the intensity value $I(x', y', z')$ of each pixel in said computed area-type 3-D image onto the x',y',z' coordinates of points on a uniformly-spaced grid surface positioned along the optical axis of said linear imaging subsystem so as to model a 2-D planar substrate on which graphical forms of intelligence on said 3-D object surface might have been originally rendered; and means, using an intensity weighing function based on the x', y', z' coordinate values of each pixel in said area-type high-resolution 3-D image, for producing an high-resolution area-type 2-D image of said 2-D planar substrate surface bearing said forms of graphical intelligence.

675. The PLIIM-based camera system of claim 675, wherein said image processing computer further comprises: an OCR algorithm for performing automated recognition of graphical forms of intelligence that might be possibly contained in said high-resolution area-type 2-D image of said 2-D planar substrate surface so as to recognize said graphical forms of intelligence, and generating symbolic knowledge structures representative thereof.

674. The PLIIM-based camera system of claim 670, wherein said linear imaging subsystem comprises a planar laser illumination and imaging (PLIIM) based linear imaging subsystem having a planar laser illumination array for producing a planar laser illumination beam that illuminates said moving 3-D object surface.

675. The PLIIM-based camera system of claim 671, wherein said LADAR-based object profiling subsystem produces a pair of AM laser beams, spaced apart at an angular separation, for capturing pairs of linear 3-D surface profile maps which are processed in order to compute the instantaneous velocity of said moving 3-D object surface.